

Insider trading and the post-earnings announcement drift

By

Christina Dargenidou, Ian Tonks, and Fanis Tsoligkas*

April 2017

Abstract:

We show that trades by corporate insiders after an earnings announcement determine the extent of the post-earnings announcement drift anomaly. Contrarian trades mitigate the under-reaction to earnings announcements, and confirmatory trades allow price movements to continue in the same direction of the earnings surprise. These results are consistent with insider trading providing relevant information on transitory or permanent changes to the earnings process that allows the market to make appropriate inferences about the nature of the earnings surprise. Further, we find that contrarian directors' trades alleviate the anomaly even under circumstances of lower earnings precision.

Keywords: Insider trading, earnings announcements, market under-reaction, market efficiency

JEL classification:
G14, M41

Christina Dargenidou, Xfi Centre for Finance and Investment, University of Exeter, Rennes Drive, Exeter, EX4 4ST. Email: C.Dargenidou@exeter.ac.uk.

Ian Tonks, School of Management, University of Bath, Claverton Down, Bath, BA2 7AY, UK. Email: I.Tonks@bath.ac.uk.

Fanis Tsoligkas, School of Management, University of Bath, Claverton Down, Bath, BA2 7AY, UK
Email: F.Tsoligkas@bath.ac.uk.

We gratefully acknowledge helpful comments and discussion received from George Bulkley, Clive Lennox, Beatriz García Osma, and seminar participants at the University of Bath, King's College London and WHU – Otto Beisheim School of Management.

1 Introduction

This paper examines the consequences of trading by corporate insiders on the well-documented post-earnings announcement drift (PEAD) anomaly, whereby large positive unexpected earnings (UE) announcements are followed by an upwards drift in security returns, and large negative UE are followed by a downwards drift. The PEAD represents an under-reaction to earnings surprises, predominantly in those stocks with the largest surprises, for both positive (good news) and negative (bad news) announcements. Using a sample of 7,980 annual earnings announcements in the U.K. over the period 1995-2013, we first report evidence of the PEAD phenomenon: the spread in returns between the top and bottom quintiles formed on the basis of UE is a significant 3.4% six months after the earnings announcement. We go on to argue that corporate insider trading in the period after the earnings announcement affects the market's learning process of whether a structural change in the earnings series has occurred by providing additional information to the market about the interpretation of the earnings surprise. We show that information in contrarian directors' trades after an earnings announcement - director sales after good news or director buys after bad news - mitigates the PEAD. The market observes the trading behaviour of directors and infers that the earnings surprise reflects only a transitory change in earnings. Conditioning on these contrarian directors' trades, we find that the top to bottom quintile spread is reduced to an insignificant -1.4% six months later. In contrast, those companies with confirmatory director trades (in the same direction as the earnings surprise: director sales after bad news or director buys after good news) are deemed by the market to signal that there has been a permanent shift in earnings whose magnitude is difficult to determine. The post-earnings quintile spread in these companies that display confirmatory directors' trades increases to a highly significant 7.3%. In the absence of any directors' trades, the market remains uncertain about the structural break. The evidence presented in this paper on the market responding to the joint signals of earnings surprises and directors trading provides support for the theory that PEAD represents a delayed learning response to the identification of permanent and transitory changes in the earnings process.

In the UK insiders are forbidden from trading up to two months before the earnings announcement, but are allowed to trade once the earnings have been released. Corporate insiders, with more information about a company's underlying value than the rest of the market, might be expected to trade if the market's reaction to the earnings surprise does not reflect this

underlying value. Francis, Lafond, Olsson, and Schipper (2007) suggest that the market's under-reaction to earnings announcements as established in the post earnings announcement drift literature (e.g. Bernard and Thomas 1990)¹, represents a delayed response to the earnings surprise as market participants learn gradually about its implication for future earnings (Soffer and Lys 1999). Learning models predict that investors' under-react to information signals after a structural shift has occurred, because there is uncertainty as to whether a structural shift has in fact happened (Timmermann 1993; Brav and Heaton 2002). Francis et al (2007) demonstrate that the PEAD anomaly is driven by information uncertainty captured by the quality of underlying earnings.

In a similar vein, we argue that the trading behaviour of corporate insiders is information that investors use to address the inference problem as to whether a structural shift in the earnings process has occurred. Investors who observe the direction of corporate insider trading are able to infer directors' private information about the earnings surprise. We follow Seyhun (1998) and identify a set of contrarian insider trades, taking place after the earnings announcement but in the opposite direction to the sign of the earnings surprise. These trades provide a signal to the market that the earnings surprise denotes a transitory realization, and the market's response reverses the initial reaction to the earnings announcements. The remaining set of insider trades occur in the same direction as the earnings surprise which we classify as confirmatory trades. These trades signal that informed insiders believe that the earnings surprise represents information about a permanent change in the earnings process. The market updates its beliefs about the permanent-transitory nature of earnings on the basis of this additional information and in the case of confirmatory directors' trades, the initial under-reaction to the earnings surprise will be adjusted as prices continue to move in the same direction as the surprise.

Francis et al. (2007) predict that the under-reaction to earnings announcements is negatively associated with the level of the precision of the earnings signal. This is because investors' learning is delayed when the earnings signal is less precise as the earnings process is more hard-to-value. We extend this line of reasoning and examine the effect of interacting

¹ A comprehensive literature review of the PEAD can be found in Richardson, Tuna, and Wysocki (2010) and Kothari (2001). In summary, the PEAD has been attributed to a risk explanation (Kim and Kim 2003), limits to arbitrage (Ng, Rusticus, and Verdi 2008; Mendenhall 2004), cognitive biases (Liang 2003; Dellavigna and Pollet 2009; Hirshleifer, Lim, and Teoh 2009), investors' lack of sophistication (Bartov, Radhakrishnan, and Krinsky 2000; Battalio and Mendenhall 2005) and investors' learning or "rational structural uncertainty" (Francis et al. 2007; Chordia and Shivakumar 2005; Vega 2006).

the precision of the earnings signals with corporate insider trading. These interactions allow us to interpret the way information on directors' trading is employed by investors. We demonstrate that in the presence of contrarian insider trading after the earnings announcement, there is no under-reaction to earnings announcements in firms with low earnings precision. The implication is that in these hard-to-value cases, contrarian directors' trades allows the market to interpret the earnings surprise as a temporary event. This is not the case in the other scenarios, (*i.e.*, in the presence of confirmatory trading or in the absence of insider trading) where the under-reaction is still significant. These findings support the role of contrarian insider trading in particular in accelerating investors' learning following an earnings announcement.

Our research contributes to the literature that has examined whether insider trading provides relevant information in the valuation of corporate earnings (e.g. Udpa 1996; Veenman 2012; Roulstone 2008; Beneish and Vargus 2002). Udpa (1996) shows that insider trading prior to an earnings announcement mitigates the market reaction to the subsequent earnings announcement. In a similar vein, Roulstone (2008) reports that insider purchases and sales result in lower market reaction during the earnings announcement. These results suggest that the information contained in directors' trading allows the market to develop inferences about future earnings. Beneish and Vargus (2002) find that the persistence of the discretionary component of accruals in earnings is greater when accompanied by directors' purchases and less persistent when accompanied by sales. However, none of these studies focus on insider trading taking place after an earnings announcement. The only exception is Veenman (2012) who shows that purchases occurring after an earnings announcement are more informative when they confirm the initial earnings surprise and concludes that their disclosure is a useful signal for market participants to value past earnings. While Veenman (2012) focuses on the short-run market reaction around the filing day of an insider trade, we adopt a longer six-month window and focus on the implications of both insider purchases and sales on the post earnings announcement drift. This is important because our approach explains how insider trading contributes to understanding well-known stock market anomaly, and enhance market efficiency.

A related study by Kolasinski and Li (2010) also examines insider trading after the earnings announcement, and focuses on whether insiders exploit the initial under-reaction to an earnings announcement. In contrast, we contribute by showing how investors employ the information in directors' trading to draw inferences on the permanent-transitory nature of the

earnings surprise. The UK provides a unique setting for this investigation since the institutional arrangements allow first, directors to trade immediately after the earnings announcement and associated trading ban, and second, a speedy disclosure of transactions.

The remainder of the paper is structured as follows: in Section 2 we discuss the regulation and practices with respect to insider trading around earning announcements in the UK. In Section 3 we develop our hypotheses on how contrarian and confirmatory insider trading provides information on the interpretation of the earnings surprises. We explain the methodology that we employ to test our hypotheses in Section 4, and in Section 5, we describe the data and the construction of our variables. Section 6 reports our findings, and finally in Section 7, we present the conclusions to the study.

2 Insider trading around earnings announcements: Regulation and practices in the UK

The regulatory framework and common practices in the UK allow us to determine the timing of transactions which are most likely to convey insiders' private information about the interpretation of the earnings surprise. Insider trading on price sensitive information and in particular the trades by directors in the UK are regulated by The Companies Act 1985, The Criminal Justice Act (CJA) 1993, The Financial Services and Markets Act (FSMA) 2000, Listing Rules and Disclosure Rules administered by the Financial Conduct Authority, who may impose penalties such as fines or imprisonment to insiders found guilty of trading on inside information. The London Stock Exchange Model Code (1977) (part of the Listing Rules), requires directors who trade in their own company's shares first, to seek clearance to trade from the Board ahead of the transaction and second, to report their trades to the company no later than the fourth day after the transaction occurred.² In turn, the company must notify the Stock Exchange no later than the following day, when the information about the trade is disseminated to the market. Although the duration of this process appears to be lengthy, in practice, the disclosure of insider trades in the UK is very timely. Fidrmuc, Goergen, and Renneboog (2006) report that 85% of the directors trades in the UK are announced to the market either on the same day they occur or on the following day, and this is confirmed in our data, with 82.11% of

² Insiders in the UK are normally interpreted to be executive and non-executive directors of the company. Thus, we use the terms "insiders" and "directors" interchangeably to refer to corporate insiders.

the shares traded within the first 10 trading days after and including the earnings announcement day, being disclosed on the same or following day.

In addition, the Model Code prescribes a clearly-defined and well observed trading ban,³ forbidding insiders from trading for two months prior to the earnings announcement. The purpose of this trading ban is to prevent insiders from exploiting any private information with respect to the forthcoming earnings announcement. However, an insider may trade after the end of the trading ban, with the trading restriction ending immediately after the earnings announcement has been made public. Our analysis will focus on these directors' transactions taking place shortly after the earning announcement.

3 Hypothesis development

In this section we develop our hypotheses concerning the impact of corporate insider trading on the post-earnings announcement drift – the market's under-reaction to earnings announcements. We argue that trading by corporate insiders allows the market to make improved inferences about changes in the underlying earning process and that such revisions can explain the PEAD. Bulkley and Tonks (1989), Timmermann (1993) and Timmermann (1996) have shown that since standard valuation models rely on estimates of the growth process for dividends and earnings as inputs, small revisions to these growth estimates can generate large changes in equity values and this can explain the observed excess volatility of stock prices. Investors form expectations of future fundamentals such as earnings or dividends based in part on the time series properties of previous fundamentals. They update their beliefs about these estimates as new data on dividends and earnings become available. When a large surprise in earnings is announced, whether positive or negative, investors must decide whether this change represents a transitory or permanent variation in earnings. If the nature of the change in earnings is transitory, then the value of the company will only change by the contemporaneous change in the most recent earnings level, and Freeman and Tse (1992) show that transitory earnings have small or no impact on prices. On the other hand, if a structural change has occurred in the earnings process, then the announced earnings represent the first realisation from a new earnings process, and the value of the firm should change to reflect the

³ The trading ban in the UK is well observed since it has been shown (e.g. Hillier and Marshall 1998, 2002a; Korczak, Korczak, and Lasfer 2010) that directors either abstain from trading during this period, or trade with the permission of the company chairperson.

new earnings process. Investors face an identification problem from the most recent earnings figure, as to whether the unexpected value is an outlier from the previous earnings process, or is the first observation in a new earnings series. Brav and Heaton (2002) develop a structural uncertainty model that explains investors' under-reaction to earnings surprises in terms of a delayed response from a rational learning model. Lewellen and Shanken (2002) and Pastor and Veronesi (2009) also develop rational learning models where investors under-react to information signals after a structural shift has occurred, because there may be some uncertainty as to whether a structural shift has in fact happened.

In such an environment investors will look around for further information that will allow them to make a better inference on the transitory or permanent shock to earnings. One such source of information is the trading behaviour of corporate insiders, who are allowed to trade after the earnings announcement in the UK following the relaxation of the two-month prior trading ban. It has been shown that insider trading enables private information held by corporate insiders to be incorporated into stock market prices (Manne 1966; Leland 1992). Empirical evidence has demonstrated that information in directors' trading is associated with significant market reactions (Gregory, Matatko, and Tonks 1997; Lakonishok and Lee 2001; Fidrmuc et al. 2006; Veenman 2012; Brochet 2010).

Previous research e.g. Garfinkel (1997), Seyhun (1998), Hillier and Marshall (2002b) and Huddart, Ke, and Shi (2007) has established trading patterns around the earnings announcement that illustrate insiders' informational advantages. Seyhun (1998) notes that an insider who wants to purchase shares and anticipates a negative earnings surprise will hold back from trading until after the bad news has been announced in order to buy shares at a lower price. Conversely, an insider who wishes to sell and anticipates a positive earnings surprise will again postpone trading until after the public announcement, in order to sell at a higher price. These contrarian trading patterns are motivated by insiders' informational advantages that the earnings surprise represents a transitory event. Specifically, Seyhun (1998) argues that "Following their sales, insiders do not necessarily expect negative future performance. They only know that past expectation of good performance is completed and the stock price fully reflects insiders' expectations." (p 51). Following Seyhun (1998) and others (Garfinkel 1997; Seyhun 1998; Hillier and Marshall 2002a; Huddart et al. 2007), we argue that the contrarian direction of these insider trades reveals that prices have over-reacted to the information in the earnings surprise, with the implication that such earnings surprises represent only a transitory change in earnings. The contrarian nature of these trades provide a contradictory signal to the

earnings surprise, and causes market participants to revise their expectations in the opposite direction to the sign of the earnings surprise. The joint signal of an earnings surprise and a contrarian directors' trade, allows investors to infer that the earnings surprise does not reflect a permanent change in earnings, and we would not expect any further movement in prices in the direction of the earnings surprise; in fact, PEAD will be dissipated.

Following these discussions, we set out our first hypothesis:

Hypothesis 1 (H1): Informed contrarian directors' trading after an earnings announcement conveys relevant information on the transitory nature of the earnings surprise that attenuates the PEAD.

We now turn to the other type of insider trading around the earnings announcement: confirmatory insider trades. Confirmatory insider trades are those directors' trades that occur after the earnings announcement and in the same direction as the sign of the earnings surprise. From these trades investors infer that there has been a permanent shift in the earnings process, since with confirmatory trades informed insiders are either buying shares after the good earnings news, or selling shares after the announcement of a bad earnings surprise. In both cases confirmatory directors' trading reveal a mis-valuation of market prices from the underlying firm fundamental, and that the initial price reaction was an under-reaction to the earnings surprise. The direction of these confirmatory trades indicate that prices have still to fully reflect the information in the earnings surprise. This behaviour is consistent with the latest earnings figure representing a permanent change to the earnings process. However, there are two issues in relation to the inferences that the market makes from confirmatory directors' trades.

First, the absolute upper limit on the permanent change in earnings is undefined whether for good news or bad news. Although the market may infer from the confirmatory trades that there has been a permanent change in earnings, the parameters of this new earnings process are not yet known, and there is still much uncertainty about the ultimate equilibrium share price.⁴ So although the joint signal of confirmatory trades and the earnings surprise indicates that a structural break has occurred, it is well-known that analysts typically under-estimate the extent of earnings changes (Mendenhall 1991; Abarbanell and Bernard 1992). Further, Ali, Klein, and Rosenfeld (1992) show this under-estimation is more severe when earnings are deemed

⁴ A similar issue arises in the case of insider trading around earnings restatements. Badertscher, Hribar, and Jenkins (2011) argue that it is only possible to identify directional hypotheses about how stock prices respond to insider trading and accounting restatements, not the rank order of the magnitude of the effects.

permanent. It is therefore unlikely that with a joint signal of an earnings surprise and a confirmatory insider trade prices will immediately jump to a new equilibrium level. It is more likely that there will be subsequent drift or a delayed response to the new equilibrium given that even professional investors (e.g. analysts) under-estimate the permanence of the structural change.

Second, insiders have reduced incentives to engage in confirmatory trading after the earnings announcement, given that the earnings surprise reveals in part the insiders' information. Directors would have greater incentives to trade prior to the earnings announcement to fully exploit their private information about the forthcoming earnings surprise. In the context of the UK's two month trading ban, an insider would purchase (sell) shares before the announcement of a positive (negative) earnings surprise, just prior to the imposition of the trading ban. However, pre-earnings announcement insider trading is rare as it exposes insiders to both litigation and reputation costs. Hillier and Marshall (2002a) report that although insiders with private information about the upcoming earnings announcement may trade prior to the start of the trading ban period, the transparency of the trading disclosures and the legal consequences means that such trades are uncommon. Piotroski and Roulstone (2007) show that insiders refrain from pre-earnings announcement trades when the magnitude of the surprise is extreme. Also, there is evidence of a substantially higher incidence of directors' trading in the period following the earnings announcement, and this is consistent with insiders' reluctance to trade before the announcement and preference to delay their trades (Sivakumar and Waymire 1994; Huddart et al. 2007; Hillier and Marshall 2002a). Veenman (2012) examines short-run stock market responses to directors' buys after earnings announcements, and suggests that such purchases following the announcement of positive unexpected earnings are more likely to be motivated by information about future events and future earnings, rather than the most recent earnings surprise.

In summary, although the patterns associated with confirmatory insider trading are consistent with insiders exploiting their informational advantage over the interpretation of the earnings surprise, we anticipate the asymmetric incentives (compared with contrarian trades) may render a delayed stock market response to the earnings surprise. This discussion leads us to our second hypothesis:

Hypothesis 2 (H2): Informed confirmatory directors' trading after an earnings announcement provides information on the permanent nature of the earnings surprise and allows for a continuation of the PEAD.

The underlying conjecture in the development of hypotheses H1 and H2 is that the disclosure of informed directors' trading provides relevant information to the market which accelerates investors' learning with regards to the transitory-permanent nature of the earnings surprise and thus, either attenuates or strengthens the under-reaction to the earnings announcement. We may seek further support for these arguments by examining these conjectures in relation to the characteristics in the earnings surprise related to the difficulty investors have in interpreting these signals. Francis et al. (2007) argues that a testable consequence of a rational learning model explanation of the PEAD is that we would expect the PEAD anomaly to be most prevalent in high information uncertainty firms where uncertainty is captured by the precision of earnings. They show that in these hard-to-value firms the under-reaction to earnings announcements is exacerbated by the low precision in earnings signals since the investors' inference problem is more complex for these cases, and the speed at which investors incorporate the information in the earnings surprise is delayed. Veenman (2012) and Bhattacharya, Desai, and Venkataraman (2013) argue that low precision in the earnings signal amplifies the information asymmetry between insiders and outsiders, and thereby increases the importance of insiders' private information for investors' assessments.

In our context, the disclosure of insider trading conveys insiders' informational advantages with respect to the interpretation of the earnings surprise and addresses the uncertainty that otherwise arises from low earnings signal precision. Specifically, we conjecture that under circumstances of low earnings precision, the disclosure of contrarian insider trading becomes more valuable by revealing information that reduces the market under-reaction to earnings announcement. This discussion leads us to our third hypothesis H3:

Hypothesis 3 (H3): Contrarian insider trading attenuates the under-reaction to earnings announcements for low earnings precision (high information uncertainty) announcements by accelerating investors' learning.

H3 seeks to corroborate the role of informed contrarian insider trading as a means for accelerating investors' learning by testing it under those conditions where we expect a delay in investors' learning, *i.e.*, low precision earnings signals. Evidence of an insignificant under-reaction under circumstances when it is more likely to occur, validates the mechanism through which contrarian insider trading enhances market efficiency. We might anticipate a corollary of H2 with respect to confirmatory trades in low precision firms; however we have already argued in developing hypothesis H2, that we expect the presence of confirmatory insider

trading to have a more muted effect on PEAD. We can only conjecture that the low earnings signal precision aggravates the inference problem of investors' observing confirmatory trades.

Hypothesis H3 is also silent with respect to the effects of contrarian or confirmatory insider trading on the under-reaction to earnings in firms with high earnings precision, which we model through interaction effects. We acknowledge that there is no prior literature to provide a prediction in this respect. These interactions remain an empirical question, and their investigation may yield insights on investors' information acquisition process in the presence of insider trading. To summarise, our main hypotheses H1 and H2 are concerned with the role of informed contrarian and confirmatory insider trading in explaining the PEAD. Hypothesis H3 complements the first two hypotheses, since it aims to corroborate the role of insider trading in the context of low earnings precision firms.

4 Research design

To investigate the effect of informed insider trading on the under-reaction to earnings announcements, we follow the event-study methodology to first identify the post-earnings announcement drift (e.g. Bartov et al. 2000) and then to include variables that examine the impact of contrarian and confirmatory directors' trading. Evidence of the under-reaction to earnings announcements is documented by a significant association between the earnings surprise and subsequent returns, as follows:

$$BHAR_{i,t} = \alpha_0 + \alpha_1 RUE_{i,t} + Controls_{i,t} + \varepsilon_{i,t} \quad (1)$$

where, $BHAR_{i,t}$ denotes market adjusted buy-and-hold abnormal returns using the FTSE all share marked index measured from 11 days after the earnings announcement to six months later, where a month is defined in terms of 21 trading days, and $RUE_{i,t}$ is the rescaled quintile rank of the earnings surprise. We first calculate unexpected earnings defined as the quintile rank of the earnings surprise, where the cut-off points are determined by the distribution of the earnings surprise in the previous year. We define the earnings surprise based on the difference between actual earnings and the latest analysts' earnings forecast (e.g. Ayers, Li, and Yeung 2011; Brown and Kim 1991). We follow Mendenhall (2004) and Affleck-Graves and Mendenhall (1992) to define $RUE_{i,t}$ as a variable taking the value "-0.5" when an observation belongs to the bottom quintile rank of earnings surprise and "0.5" when an observation belongs

to the top quintile rank of earnings surprise. With respect to the intermediate quintiles, we follow Core, Guay, Richardson, and Verdi (2006) and set $RUE_{i,t}$ to be equal to zero. In this case, the difference between the extreme earnings surprise quintiles is equal to unity and therefore, α_1 represents the spread in average abnormal returns between observations in the highest and lowest unexpected earnings surprise quintiles. We control for the effect of size, momentum and book-to-market by means of the quintile rank of the corresponding variables (e.g. Hirshleifer, Myers, Myers, and Teoh 2008; Louis and Sun 2011). Based on the evidence for the PEAD reported for the UK (Hew, Skerratt, Strong, and Walker 1996; Liu, Strong, and Xu 2003) and the US (e.g. Ball and Brown 1968; Ayers et al. 2011), we predict a positive and statistically significant coefficient α_1 denoting an abnormal returns continuation along the sign of the earnings surprise $RUE_{i,t}$. In order to test Hypotheses H1 and H2, we adjust (1) by partitioning the association between the earnings surprise and subsequent returns in the presence of informed contrarian ($Ctrar$) and confirmatory ($Cfirm$) insider trading. More specifically, we modify (1) as follows:

$$BHAR_{i,t} = b_0 + b_1 Ctrar_RUE_{i,t} + b_2 Cfirm_RUE_{i,t} + b_3 NT_RUE_{i,t} + b_4 Ctrar_{i,t} + b_5 Cfirm_{i,t} + b_6 Controls_{i,t} + \varepsilon_{i,t} \quad (2)$$

where, $Ctrar_RUE_{i,t}$ equals to $RUE_{i,t}$ when directors engage in contrarian trading after the earnings announcement, and zero otherwise; $Cfirm_RUE_{i,t}$ equals to $RUE_{i,t}$ when directors engage in confirmatory trading after the earnings announcement, and zero otherwise; $NT_RUE_{i,t}$ equals to $RUE_{i,t}$ when directors abstain from trading after the earnings announcement, and zero otherwise. We also include the main effects of $Ctrar_{i,t}$ and $Cfirm_{i,t}$ in order to control for the possible effect of contrarian and confirmatory trading on subsequent abnormal returns.

Hypothesis H1 postulates that contrarian insider trading conveys useful information on the transitory nature of the earnings surprise that attenuates the under-reaction to earnings announcements, and we expect the coefficient b_1 to be insignificant indicating that the earnings surprise is not associated with a subsequent drift. H2 predicts that the presence of confirmatory insider trades will convey information about the permanent nature of the earnings surprise, which nevertheless, involves significant uncertainty and thus, there will be a continuation of the PEAD. Therefore, we expect the coefficient b_2 to be positive and significant. Additionally, the absence of any insider trading implies that the additional information needed to allow the

market to interpret the permanent-transitory nature of the earnings surprise is not available. Given the asymmetric incentives for contrarian and confirmatory trades, the absence of any directors' trades is more likely to be taken by the market as indicating a permanent change in the earnings process and we expect the coefficient b_3 to be positive and significant. Furthermore, we seek to corroborate the distinct role of directors' trading in promoting efficient stock prices as set out in H1 and H2 by comparing coefficient b_1 with coefficients b_2 and b_3 .

In order to test Hypothesis H3, we need to obtain an estimate of the earnings signal precision. Following Francis et al. (2007) we measure the earnings signal precision by means of the magnitude of discretionary accruals.⁵ To construct our measure of earnings precision, we rank firms annually based on the magnitude of their discretionary accruals. We assign an earnings precision variable (PREC) the value of 1 if a firm belongs to the bottom tercile of this ranking, and 0 otherwise. Observations ranked in the bottom tercile of the unsigned discretionary accruals' distribution are considered to exhibit high earnings signal precision (PREC=1) while the remaining observations are considered to exhibit low levels of precision (PREC=0).

Equation (3) then enables us to test H3 by examining the association between the earnings surprise and subsequent returns, as described in (2), conditioning on the earnings signal precision (PREC).

$$\begin{aligned}
BHAR_{i,t} = & b_0 + b_1Ctrar_RUE_{i,t} + b_2Cfirm_RUE_{i,t} + b_3NT_RUE_{i,t} \\
& + b_4Ctrar_RUE_{i,t}*PREC_{i,t} + b_5Cfirm_RUE_{i,t}*PREC_{i,t} + b_6NT_RUE_{i,t}*PREC_{i,t} \\
& + b_7Ctrar_{i,t} + b_8Cfirm_{i,t} + b_9PREC_{i,t} + b_{10}Controls_{i,t} + \varepsilon_{i,t}
\end{aligned} \tag{3}$$

The coefficients of interest in (3) are the coefficients b_1 , b_2 and b_3 . Those coefficients represent respectively, the influence of contrarian insider trading, confirmatory insider trading and absence of trading on the under-reaction to earnings announcements under circumstances that delay investors' learning, *i.e.*, low earnings precision. Consistent with the distinctive ability of contrarian insider trading to facilitate investors' learning predicted in hypothesis

⁵ The main tests in Francis et al. (2007) employ a model that relies on a long time series of data and is based on Dechow and Dichev (2002). However, they report similar results when using the proxy that we employ here (cf. page 427 of their paper).

development, we expect that b_1 would not only be insignificant but also, significantly different from the positive and significant coefficients b_2 and b_3 .

As already discussed, we have no particular predictions with respect to the incremental influence of earnings precision on the under-reaction in the presence of insider trading. We note though, that in line with the evidence in Francis et al. (2007), we expect that the precision in the earnings signal would moderate the under-reaction to earnings announcements, at least in the absence of insider trading, denoted by a negative and significant coefficient b_6 . This is because in the absence of insider trading, we expect that the information acquisition process is largely based on the underlying fundamentals. The signs of the remaining coefficients, b_4 and b_5 however, depend on how investors conduct their information acquisition process in the presence of insider trading. Since we have no priors in this respect, we refrain from making any further predictions.

5 Data and empirical proxies

5.1 Data

We collect data for all UK non-financial listed companies whose financial year end date falls between 1995 and 2013 yielding an initial sample of 19,804 firm-year observations. Requiring an intersection between I/B/E/S Detail History files and Datastream to allow us to collect the necessary data for estimating our earnings surprise variable, loses 9,366 data points mainly due to missing earnings announcements.⁶ We follow (e.g. Ayers et al. 2011; Brown and Kim 1991) and define the earnings surprise as follows:

$$UE_{i,t} = (Actual_EPS_{i,t} - Forecasted_EPS_{i,t}) / P_{i,t-1}$$

where, $Actual_EPS_{i,t}$ is the actual earnings per share reported in I/B/E/S for year t ; $Forecasted_EPS_{i,t}$ is the single most recent forecast made by the timeliest analysts prior to the

⁶ We require the earnings announcements to be available in Datastream or I/B/E/S. After eliminating earnings announcements announced more than 200 days after the fiscal year end, we supplement the earnings announcements in Datastream from I/B/E/S and choose the earliest given the concerns of I/B/E/S reliability (Hung, Li, and Wang 2014).

earnings announcement;^{7,8} and $P_{i,t-1}$ is the stock price at the previous fiscal year end. We convert $UE_{i,t}$ into quintiles of earnings surprises based on the magnitude of the surprise. We acknowledge that not all companies announce earnings at the same time and the distribution of earnings surprises might not be known prior to the portfolio formation date. Therefore, we define the quintiles of the earnings surprises from the distribution of the preceding year's surprises. We further eliminate 2,044 observations due to missing market data from Datastream, and a further 7 observations are eliminated due to missing accounting data that are necessary for the calculation of discretionary accruals.⁹ Trimming buy-and-hold abnormal returns as well as the variables involved in the estimation of the discretionary accruals at the 2st and 98th percentiles of their distributions reduces further the sample by 334 firm-year observations. These selection criteria yields a final sample of 7,980 firm-year observations from 1,373 different firms. Table 1 summarises the sample selection procedure.

TABLE 1 ABOUT HERE

5.2 Abnormal returns

We measure the post earnings announcement returns as the buy-and-hold market adjusted returns beginning from the 11th day and ending six months later, relative to the earnings announcement. We calculate returns using daily prices and dividends from Datastream given the concerns in Ince and Porter (2006) with regard to returns estimated from the Return Index (RI) data-item. Following Lee (2011) we drop any day where more than 90% of the shares outstanding are not traded (i.e. have zero return on that day). Furthermore, in order to filter out suspicious stock returns, we follow Chui, Titman, and Wei (2010) and set returns that are greater than 100% (-95%) equal to 100% (-95%). Finally, thin trading leading to missing returns may also compromise our statistical inferences, and therefore, we calculate both trade-to-trade returns and lumped returns (Campbell, Cowan, and Salotti 2010; Maynes and Rumsey 1993). Specifically, trade-to-trade returns are calculated from non-missing price days. For a stock with a missing price, the corresponding portfolio return is added to the next non-missing

⁷ Following Bartov, Givoly, and Hayn (2002), we only consider the latest forecast preceding the earnings announcement by at least three days. We acknowledge that using the latest forecast is quite common (e.g. Ayers et al. 2011; Bartov et al. 2002; Brown and Caylor 2005) and is known to be more closely related to the market reaction at the earnings announcement (Brown and Kim 1991). We further exclude forecasts preceding the earnings announcement by more than 200 days to prevent stale forecasts being included in the analysis. Bartov et al. (2002) also follow a similar approach.

⁸ We further exclude earnings announcements taking place after 200 days from the fiscal year end.

⁹ We eliminate firm year observations whose accounting reporting period is less than 340 and more than 380 days (similarly to García Lara, García Osma, and Mora 2005).

price day's portfolio return for a trade-to-trade abnormal return calculation. Alternatively, lumped returns consist of trade-to-trade returns on non-missing price days and zero on missing price days with no adjustment to the portfolio return when returns are missing, given that procedure does not allow for missing returns. In addition, to avoid abnormal returns being influenced by our thin trading adjustments, we follow Hung et al. (2014) and require firms to be traded for at least 70% of the trading days within our measurement period.

5.3 Insider trading

Information on directors' trading is from the Hemmington Scott Directors' Trading Dataset. In line with prior research in the UK (e.g. Pope, Morris, and Peel 1990; Gregory, Matatko, Tonks, and Purkis 1994; Hillier and Marshall 2002b; Fidrmuc et al. 2006), we define insider transactions as purchases or sales by both executive and non-executive directors. Following prior research (Core et al. 2006; Sawicki and Shrestha 2008; Beneish and Vargus 2002; Beneish, Press, and Vargus 2012; John and Lang 1991), we employ a firm-specific measure of net insider trading, aggregating all directors' trading activity within a period, namely the net purchase ratio as follows:

$$NPR = [PURCHASES - SALES] / [PURCHASES + SALES]$$

where *PURCHASES* is the number of shares purchased by directors and *SALES* is the number of shares sold. A positive *NPR* could be the result of directors purchasing more shares or selling fewer shares and *vice versa* for a negative *NPR*. A positive *NPR* indicates net insider buying, whereas a negative *NPR* indicates net insider selling. *NPR* is estimated only using open market purchases and sales of common shares. The need to focus on open market transactions is also confirmed by the findings in Veenman, Hodgson, Van Praag, and Zhang (2011) who show that only open market purchases are associated with positive future news as opposed to stock options conversions. We identify insider trading transactions that take place and are disclosed within the first ten days after and including the earnings announcement, which also coincides with the end of the trading ban. Figure 1 shows the number of daily insider trading transactions across all firms in our data set around the time of an earnings announcement (day 0), from 72 days before the earnings announcement to 10 days after. The two-month trading ban is effective from around 42 trading days before the earnings announcement, and the figure includes thirty days before the start of the trading ban.

FIGURE 1 ABOUT HERE

The information presented in Figure 1 indicates that the incidence of directors' trading in the period after the earnings announcement is dramatically higher than in the period before the earnings announcement. This finding confirms insiders' reluctance to trade before the announcement and preference to delay their trades as the former may expose them to litigation or reputation costs. In particular, the patterns of directors trading presented on Figure 1 demonstrate that directors' trades occur as early as the earnings announcement day and these trades are disclosed to the market in a timely fashion. The pronounced spike in directors trading activity on the earnings announcement date confirms that the trades that we investigate here tend to reflect insiders' information with regard to the content of the earnings surprise rather than a response to the market's reaction to the earnings surprise as in Kolasinski and Li (2010).

5.4 Discretionary accruals

We estimate discretionary accruals in a two-stage procedure. In the first stage we use the Modified Jones (1991) model to predict the level of "non-discretionary" accruals as a function of the growth in revenues and gross property, plant and equipment. Specifically, we run a regression of total accruals for firm i , year t and sector j (two-digit ICB industry classification¹⁰) on the change in revenues and gross property, plant and equipment where all variables are scaled by the beginning total assets for each year. The second stage predicts the non-discretionary component of accruals using the estimated coefficients from the first stage. Note that in second stage, the influence of the cash sales is also taken into account by introducing the change in receivables, similarly to Dechow *et al.* (1995).¹¹ The "non-discretionary" part of the accruals then represents an estimate of the expected level of accruals and the remaining component is presumed to include managements' discretion on accruals. Moreover, since performance might also be a determinant of the level of accruals, the estimated discretionary accruals here are also "performance adjusted" in the manner advocated by Kothari *et al.* (2005) by adding return on assets (ROA) as an additional explanatory variable in both stages.

¹⁰ The two digit ICB provides 15 industry classifications where the equivalent SIC leads to 66 industry classifications, excluding missing and financial observations. We require at least 6 observations for each industry-year sub-sample (similarly to García Lara *et al.* 2005).

¹¹ The change in receivables is included in order to control for managers' attempts to manipulate earnings through discretionary revenues. For instance, managers may use their discretion to recognise revenues for which cash has yet to be received or have yet to be earned. This situation would result in reporting increased sales and accruals through increased receivables (Dechow *et al.* 1995).

Since firms do not announce their earnings at the same day or time of the year, the variables used to calculate discretionary accruals are not available for all firms in the same industry-year portfolio. Therefore the entire distribution of discretionary accruals is typically unknown to the investors at the earnings announcement and, as a result, the hedge portfolio strategies that underlie our investigation cannot be implemented. Following Louis and Sun (2011), we address this issue by estimating the accrual model one year prior to the portfolio formation and then apply the estimated coefficients to the second stage of the estimation process.

6 Analysis

6.1 Results

Table 2 presents the initial univariate evidence on the post earnings announcement buy-and-hold market adjusted abnormal returns over the six month period from day +11 after the earnings announcement. We use the FTSE all share market index to estimate the market return, and report both trade-to-trade and lumped daily abnormal returns. Panel A shows returns corresponding to the top and bottom quintiles of earnings surprises. The spread in returns between the top and bottom quintiles supports the presence of under-reaction to the earnings announcement. . The average abnormal trade-to-trade returns in the top quintile of earnings surprises are larger at 2.3% than those in the bottom quintile (-1.1%), and this difference of +3.4% is statistically significant, confirming the presence of the PEAD anomaly in the UK.

TABLE 2 ABOUT HERE

Panel B of Table 2 demonstrates the effect of conditioning these buy-and-hold abnormal returns on contrarian insider trading. In the presence of contrarian insider trading, the average buy and hold abnormal return over six months following the earnings announcement for the observations in the top quintile of the earnings surprise has a smaller magnitude than the corresponding figure for the observations in the bottom quintile. Moreover, the magnitude of the returns in both quintiles is low and not significantly different from zero. Confirming our first hypothesis H1, this finding suggests that in the presence of contrarian trades, the market interprets the earnings surprise as a transitory change in the earnings process and thus, does not capitalise its magnitude into share prices: there is no subsequent market reaction and the PEAD is mitigated. In contrast, the results in Panel C show that when there are confirmatory insider trades, the market infers that there has been a permanent change in the earnings process. Prices continue to move along the direction of the earnings surprise indicating that the market

considers that the earnings surprise has information about a permanent change in the earnings process. The PEAD anomaly is particularly pronounced among this set of observations as the return spread between top and bottom earnings surprise quintiles is 7.3%. This result is driven by directors' purchases after a positive earnings surprise rather than directors' sales after a negative surprise. We attribute this result to the market's uncertainty with respect to extent of the earnings surprise permanence – possibly because purchases are a credible signal of good prospects.

Table 3 presents the multivariate implementation of model (1) and reports evidence of an under-reaction to earning announcements after controlling for the effects of size, momentum and the book-to-market ratio (e.g. Hirshleifer et al. 2008; Louis and Sun 2011). In addition, the regression employed here takes into account the panel structure of the data using firm- clustered standard errors and year fixed effects. Evidence on the PEAD anomaly is conveyed by the positive and significant coefficient of RUE ; as explained in Section 4, $RUE_{i,t}$ is a variable taking the value “-0.5” when an observation belongs to the bottom quintile rank of earnings surprise and “0.5” when an observation belongs to the top quintile rank of earnings surprise. This allows the difference between the extreme earnings surprise quintiles to be equal to unity and therefore, the coefficient on RUE represent the spread in average abnormal returns between observations in the highest and lowest unexpected earnings surprise quintiles. The results reported in the first and the third column of Table 3, corresponding to the trade-to-trade and lumped returns, suggest evidence of PEAD (0.025; p-value<0.05) even after controlling for size, momentum and book to market effects.

TABLE 3 ABOUT HERE

The results from testing hypotheses H1 and H2 in the multivariate case from the model outlined in (2) are reported in the second and fourth columns of Table 3. Consistent with our univariate tests, we find no significant evidence of under-reaction to the earnings surprise in the presence of contrarian insider trading. Specifically, the coefficient on $Ctrar_RUE$ denoting the spread in average abnormal returns in the presence of contrarian trading, is -0.033 and statistically insignificant. This finding supports our hypothesis H1 with respect to the role of contrarian trading in mitigating the PEAD. In contrast, the information conveyed by confirmatory insider trading provides evidence to investors that there has been a permanent change in the earnings process, as is clear from the magnitude and the significance of coefficient on $Cfirm_RUE$ (0.093; p-value<0.01). However, the assessment of the extent to which an earnings surprise

contains permanent components is likely to be a long term process involving significant uncertainty over time, as investors struggle to determine the parameters of the new earnings process. We note that in the absence of any directors' trading there is still a significant drift as reflected by the value of the coefficient on NT_RUE (0.026; p-value<0.05). Share prices continue to move along the direction of the surprise, but the drift is less pronounced than in the case of confirmatory directors' trade.

Overall, the findings here support a unique role for directors' contrarian trading with respect to its ability to alleviate the PEAD anomaly. The unique ability of information in directors' contrarian trading to mitigate investors' uncertainty can be further confirmed by comparisons with the under-reaction in the presence of confirmatory trades (difference: -0.126; p-value<0.01) as well in the absence of insider trading (difference: -0.059; p-value<0.05).

The proposition advanced in the development of hypotheses H1 and H2 is that the disclosure of informed insider trading provides relevant information to the market that accelerates investors' learning on the transitory-permanent nature of the earnings surprise. In Table 4, we provide further support for this conjecture by examining the influence of earnings precision on the speed at which investors incorporate the news about the earnings surprise.

TABLE 4 ABOUT HERE

The first and third columns of Table 4 show the influence of our measure of earnings precision, $PREC_{it}$, on the reaction to earnings announcements. We find that the coefficient of RUE_{it} is positive and significant (0.037; p-value <0.01), while the coefficient on the interaction between RUE_{it} and $PREC_{it}$ is negative and marginally significant (-0.035; p-value<0.10). Taken together, these results indicate that high earnings precision moderates the association between unexpected earnings and post earnings announcement returns. These findings confirms the arguments in Francis et al. (2007) that low earnings precision delays investors' learning and hence, aggravates the under-reaction to earnings announcements.

The second and fourth columns in Table 4 presents the results of testing Hypothesis H3. In the case of low precision firms when there is also contrarian insider trading, we find that the coefficient on RUE_{it} , is insignificant with a value of -0.026, implying that there is no PEAD in these firms. Information in contrarian directors trading has the ability to unravel the earnings process even under low earnings signal precision, which Francis et al. (2007) had identified as being the cases that generated the under-reaction.

This finding is in contrast with the coefficients of RUE_{it} in the presence of confirmatory insider trading, where the coefficient is positive and significant (0.071; p-value <0.10) or the absence of insider trading where the coefficient is positive and strongly significant (0.043; p-value <0.01). Comparisons of the under-reaction in the presence of contrarian trading to the under-reaction in the presence of confirmatory trading or in the absence of trading confirm further the unique role of contrarian trading.

As was noted in Section 3, we do not have a prediction about the impact of an increase in the earnings signal precision in the presence of insider trading on the PEAD. The evidence reported in Table 4 suggests that our findings with respect to the role of either contrarian or confirmatory trading is robust to the influence of earnings signal precision. This is clear from the insignificant interaction coefficients between contrarian and confirmatory insider trading and $PREC_{it}$. Although we do not document any significant influence of the earnings signal precision in the presence of insider trading, we still find that in the absence of insider trading, earnings precision moderates the under-reaction to earnings announcements (-0.055; p-value <0.05). Taken together, these findings suggest insider trading after an earnings announcement dominates the effects of any financial reporting information during the investors' learning process. Notably, in the case of confirmatory trading, the increase in earnings precision fails to moderate the under-reaction to earnings announcements.

In unreported results, which are available in an on-line appendix we test whether our findings are robust to (i) the partition of our earning signal precision measure in terms of quintiles instead of terciles; (ii) the length of window over which net purchase ratio is estimated (7 days instead of 10 days).; and (iii) when we define insider trading in terms of value of shares instead of number of shares. In each case we report results that are consistent with the main findings with respect to effect of contrarian and confirmatory directors trading continue to hold.

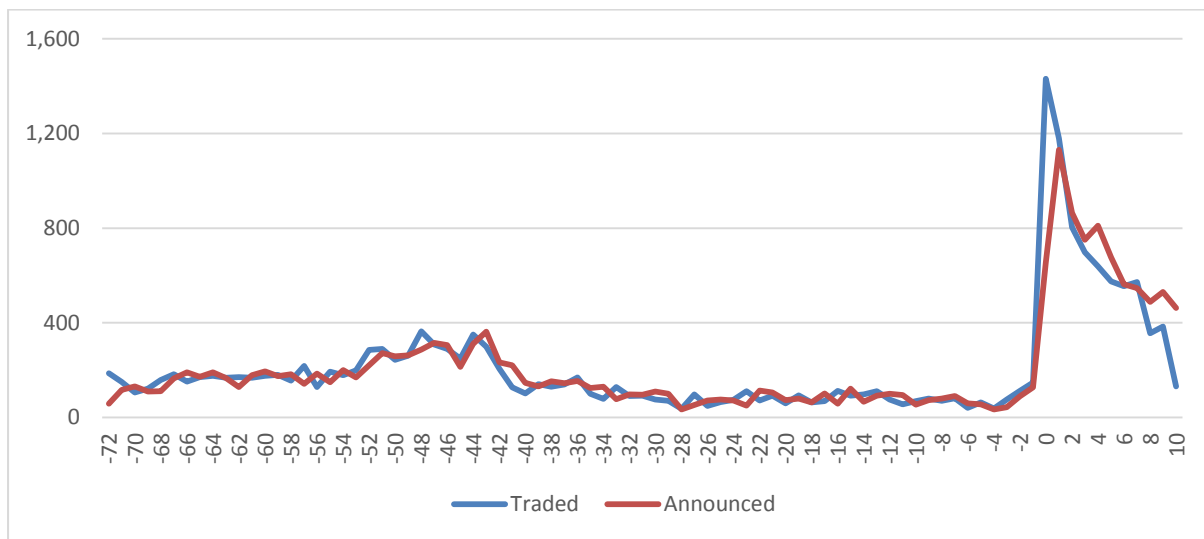
7 Conclusion

In this paper we argue that PEAD is a consequence of investors learning and updating their beliefs as to whether a structural change has occurred in the earnings process. When companies announce unexpectedly high or low earnings then investors must establish the implications of the earnings surprise for future earnings: does the earnings announcement represent a transitory change in profitability or a permanent change in earnings to a new average level? Directors trading immediately after the earnings announcement provide additional information on the

transitory or permanent nature of the earnings surprise. Given directors' access to inside information we would expect them to be in an advantageous position to assess the valuation implications of an earnings surprise. If directors sell after good news, or buy after bad news – in other words trade in a contrarian direction to the earnings surprise - this suggests that the director believes that the earnings surprise reflects only a transitory change in the earnings process and therefore, it will not support a further change in the share price along the direction of the earnings surprise. We also considered directors buying after good news and selling after bad news, and such confirmatory trades suggests investors consider the earnings surprise to represents a permanent change in earnings. Nevertheless, we note that they may have difficulty in assessing the new permanent levels of equilibrium share prices.

The present study investigates the effect that these informed trades after an earnings announcement have on the subsequent movement in stock prices. We find that conditioning stock price movements after an earnings announcement on contrarian and confirmatory directors' trades sheds light on the well-documented anomaly, the market under-reaction to earnings announcements, or PEAD. Recognising that the under-reaction represents a delayed response to the earnings surprise, we demonstrate that contrarian directors' trades mitigates the PEAD, and confirmatory trades allow for a continuation of the PEAD as prices to continue to move in the direction of the earnings surprise. When we further examine the market response to directors' trades after an earnings announcement in low earnings precision firms, we find that contrarian trades exhibit a unique ability to help the market in updating expectations and the PEAD in such hard-to-value firms was dissipated.

Figure 1: Number of directors' trades per day around earnings announcements



Notes: Figure 1 shows the total number of daily directors' trades up to 72 days before an earnings announcement and 10 days after. The trading ban operates from day -42 to day 0. Blue line denotes days when the directors' trades were transacted, and the brown line denotes days when the directors' trades were reported.

Table 1 – Sample Selection process

19,804	Initial sample of firm-year observations The initial sample consists of all publicly listed companies in the UK between 1995 and 2013 with available accounting data. In identifying the firms that have been listed in the UK, we use Datastream's research lists of active (GRP1-6) and dead companies (DEADUK1-7). From these lists we eliminate duplicates, instruments which are not classified as equity, non-primary issues and financial firms (based on ICB industry classification).
(11,824)	Total firm-year observations excluded, of which:
(9,366)	Missing earnings announcements. We require the earnings announcements to be available in Datastream or I\B\E\S. We use the earliest earnings announcement reported in Datastream I\B\E\S after eliminating earnings announcements announced 200 days after the fiscal year end.
(73)	Missing data needed to estimate unexpected earnings
(2,044)	Missing returns data needed to estimate returns
(7)	Missing accounting data needed to estimate earnings precision
(334)	Outliers removed
7,980	final sample; [firms =1,373]

Table 2: Spread returns

Panel A: Spread returns for the pooled sample			
	UE 1	UE 5	UE 5 - UE 1
N	1591	1679	
BHAR-TT			
Mean	-0.011*	0.023***	0.034***
Median	-0.001	0.019***	0.021***
BHAR-L			
Mean	-0.011*	0.023***	0.033***
Median	-0.002	0.018***	0.020***
Panel B: Spread returns in the presence of contrarian insider trading			
	UE 1	UE 5	UE 5 - UE 1
N	329	122	
BHAR-TT			
Mean	0.011	-0.004	-0.014
Median	0.033	-0.028	-0.061
BHAR-L			
Mean	0.011	-0.003	-0.014
Median	0.033	-0.028	-0.061
Panel C: Spread returns in the presence of confirmatory insider trading			
	UE 1	UE 5	UE 5 - UE 1
N	82	299	
BHAR-TT			
Mean	-0.030	0.043***	0.073**
Median	-0.023	0.048***	0.071***
BHAR-L			
Mean	-0.030	0.043***	0.073**
Median	-0.023	0.048***	0.071***

*, ** and *** denote significance at the 10%, 5% and 1% respectively.

Table shows univariate six-month buy-and-hold portfolio returns after earnings announcement for quintiles of high earnings surprises (UE 5) and low earnings surprises (UE 1), and spread portfolio between these two portfolios (UE 5 – UE 1). Panel A reports buy-and-hold returns for full sample for two thin trading adjustments: trade-to-trade, BHAR-TT, and lumped returns, BHAR-L. Panel B reports buy-and-hold returns for sample of contrarian insider trades, and Panel C reports buy-and-hold returns for sample of confirmatory insider trades.

Table 3: PEAD and the presence of informed contrarian and confirmatory insider trading.

VARIABLES	Trade to trade		Lumped	
	<i>Constant</i>	-0.098*** (-6.82)	-0.099*** (-6.92)	-0.098*** (-6.82)
<i>RUE</i>	0.025** (2.57)		0.025** (2.55)	
<i>Ctrar_RUE</i>		-0.033 (-1.23)		-0.033 (-1.21)
<i>Cfirm_RUE</i>		0.093*** (3.01)		0.093*** (2.99)
<i>NT_RUE</i>		0.026** (2.19)		0.025** (2.16)
<i>Ctrar</i>		-0.007 (-0.47)		-0.006 (-0.45)
<i>Cfirm</i>		-0.007 (-0.42)		-0.007 (-0.42)
<i>Q5MM</i>	0.091*** (9.07)	0.093*** (9.24)	0.091*** (9.05)	0.093*** (9.22)
<i>Q5BM</i>	0.026** (2.49)	0.025** (2.37)	0.026** (2.50)	0.025** (2.38)
<i>Q5MV</i>	0.028*** (2.77)	0.029*** (2.81)	0.028*** (2.74)	0.028*** (2.78)
<i>Year fixed effects</i>	Yes	Yes	Yes	Yes
<i>N</i>	7,980	7,980	7,980	7,980
<i>Adj R-squared</i>	0.0569	0.0577	0.0568	0.0575
<i>F test</i>	19.95	17.66	19.89	17.60
Wald tests testing the equality of coefficients				
		Diff		Diff
<i>Ctrar_RUE= Cfirm_RUE</i>		0.126*** (3.11)		0.126*** (3.08)
<i>Ctrar_RUE= NT_RUE</i>		0.059** (1.99)		0.058** (1.97)

Standard errors are clustered at the firm level.

*, ** and *** denote significance at the 10%, 5% and 1% respectively.

Table shows multivariate estimation of six-month buy-and-hold portfolio returns after earnings announcement for both trade-to-trade and lumped returns. First two columns report estimation of equation (1) and last two columns report estimation of equation (2). UE is quintile rank of where unexpected earnings is calculated as the difference between the I/B/E/S actual reported earnings and the single most recent forecast deflated by the stock price; RUE are rescaled unexpected earnings quintiles, and equals -0.5 if the firms belongs to the lowest quintile of UE, 0.5 if a firm belongs to top quintile of UE and zero otherwise; *Ctrar_RUE* equals to RUE in the presence of informed insider trading, and zero otherwise; *Cfirm_RUE* equals to RUE in the presence of non-informed insider trading, and zero otherwise; *NT_RUE* equals to RUE when directors abstain from trading. Controls included: *Q5MM* is the quintile rank of momentum measured as the buy-and-hold market adjusted returns over the 6 months up to the earnings announcement; *QBM* is the quintile rank of the book to market ratio; *QMV* is the quintile rank of the market value of the company measured at the fiscal year end for each company. (Note dependent variable is buy-and-hold abnormal return in excess of market return).

Table 4: PEAD and the presence of informed contrarian and confirmatory insider trading: The impact of earnings signal precision.

VARIABLES	Trade to trade		Lumped	
	<i>Constant</i>	-0.098*** (-6.83)	-0.100*** (-6.92)	-0.098*** (-6.83)
<i>RUE</i>	0.037*** (3.01)		0.036*** (2.99)	
<i>RUE*PREC</i>	-0.035* (-1.79)		-0.035* (-1.78)	
<i>Ctrar_RUE</i>		-0.026 (-0.77)		-0.025 (-0.76)
<i>Ctrar_RUE*PREC</i>		-0.023 (-0.46)		-0.023 (-0.45)
<i>Cfirm_RUE</i>		0.071* (1.82)		0.071* (1.80)
<i>Cfirm_RUE*PREC</i>		0.064 (1.24)		0.064 (1.25)
<i>NT_RUE</i>		0.043*** (3.01)		0.042*** (2.98)
<i>NT_RUE*PREC</i>		-0.055** (-2.29)		-0.055** (-2.28)
<i>PREC</i>	0.003 (0.47)	0.002 (0.25)	0.003 (0.47)	0.002 (0.25)
<i>Ctrar</i>		-0.007 (-0.48)		-0.006 (-0.46)
<i>Cfirm</i>		-0.007 (-0.42)		-0.007 (-0.42)
<i>Q5MM</i>	0.091*** (9.06)	0.092*** (9.19)	0.091*** (9.04)	0.092*** (9.17)
<i>Q5BM</i>	0.026** (2.44)	0.024** (2.31)	0.026** (2.45)	0.024** (2.32)
<i>Q5MV</i>	0.027*** (2.70)	0.028*** (2.73)	0.027*** (2.67)	0.027*** (2.71)
<i>Year fixed effects</i>	Yes	Yes	Yes	Yes
<i>N</i>	7,980	7,980	7,980	7,980
<i>Adj R-squared</i>	0.0571	0.0581	0.0570	0.0580
<i>F test</i>	18.33	15.49	18.28	15.44
Wald tests testing the equality of coefficients				
		Diff		Diff
<i>Ctrar_RUE = NT_RUE</i>		0.068* (1.87)		0.068* (1.85)
<i>Ctrar_RUE = Cfirm_RUE</i>		0.097* (1.83)		0.096* (1.82)

Standard errors are clustered at the firm level

*, ** and *** denote significance at the 10%, 5% and 1% respectively.

Table shows multivariate estimation of six-month trade-to-trade buy-and-hold portfolio returns after earnings announcement allowing for the impact of signal precision in equation (3). First two column reports estimation of equation (3) without directors' trades, and the last two columns report estimation of equation (3) with directors' trades. $PREC_i$ takes value of 1 if a firm belongs to the bottom tercile of the magnitude of discretionary accruals, and 0 otherwise. All other variables are explained in footnote to Table 3.

Appendix 1– Variables definition

VARIABLE	DEFINITION	SOURCE
BHAR-TT ^a	Buy-and-hold market adjusted abnormal return measured from +11 to +136 days relative to the earnings announcement calculated from trade to trade daily returns. For a stock not traded on a given day, the corresponding market return is added to the next non-missing price day's index return.	Prices: P Dividend: DDE Market return: FTALLSH
BHAR-L ^a	Buy-and-hold market adjusted abnormal return measured from +11 to +136 days relative to the earnings announcement calculated from lumped daily returns. For a stock not traded on a given day, daily return is treated as zero.	Prices: P Dividend: DDE Market return: FTALLSH
UE	Quintile rank of unexpected earnings. Unexpected earnings are defined as the difference between actual EPS and forecasted EPS scaled by lag price. Quintilecut-off points of the earnings surprise are based on the distribution of the preceding year's surprises.	IBES forecasted EPS: value IBES EPS: Actual forecasted EPS Prices: P
RUE	Rescaled quintile rank of unexpected earnings, which takes the value "-0.5" when an observation belongs to the bottom quintile rank of earnings surprise and "0.5" when an observation belongs to the top quintile rank of earnings surprise. Following Core et al. (2006), RUE is equal to zero for the intermediate quintiles.	IBES forecasted EPS: value IBES EPS: Actual forecasted EPS Prices: P
Q5MM	Quintile rank of momentum measured as the buy and hold market adjusted returns over the 6 months up to the earnings announcement as	Prices: P Dividend: DDE Market return: FTALLSH
Q5BM	Quintile rank of firm book-to-market	Common equity: WC03501 Market Capitalisation: WC08001
Q5MV	Quintile rank of firm size measured as the of market value of the company measured at the fiscal year end	Market Capitalisation: WC08001
Ctrar	Dummy variable which equals 1 if directors are trading in the opposite direction to the earnings surprise and zero otherwise (including no directors trades)	Directors trades: Hemscott
Cfirm	Dummy variable which equals 1 if directors are trading in the same direction of the earnings surprise and zero otherwise	Directors trades: Hemscott
Ctrar_RUE	Equals to RUE when directors are trading in the opposite direction of the earnings surprise (when Ctrar equals to 1) and zero otherwise	IBES forecasted EPS: value IBES EPS: Actual forecasted EPS Prices: P
Cfirm_RUE	Equals to RUE when directors are trading in the same direction of the earnings surprise (when Cfirm equals to 1) and zero otherwise	IBES forecasted EPS: value IBES EPS: Actual forecasted EPS Prices: P
NT_RUE	Equals to RUE when there is no directors' trading, and zero otherwise.	IBES forecasted EPS: value IBES EPS: Actual forecasted EPS Prices: P
PREC	Earnings precision variable equals to 1 if a firm's earnings are precise and zero otherwise. We define earnings precision based on the magnitude of total discretionary accruals. Firms belonging in the bottom tercile rank of the magnitude of total discretionary accruals have low levels of discretionary accruals and are deemed to report more precise earnings. The cut-off points of the tercile ranks are determined by the distribution of the magnitude of discretionary accruals at the year before. Discretionary accruals are estimated based on the modified Jones (1991) model adjusted for performance.	Income Before Extra Items: WC04001 Total Funds From Operations: WC04201 Other Funds From Operations: WC04831 Sales: WC01001 Total assets: WC02999 Receivables: WC02051 Gross Property, Plant and Equipment: WC02301

^a variable trimmed at 2% at the top and bottom of its distribution

References

- Abarbanell, J. S., and V. L. Bernard. 1992. Tests of analysts' overreaction/underreaction to earnings information as an explanation for anomalous stock price behavior. *The Journal of Finance* 47: 1181-207.
- Affleck-Graves, J., and R. R. Mendenhall. 1992. The relation between the Value Line enigma and post-earnings-announcement drift. *Journal of Financial Economics* 31: 75-96.
- Ali, A., A. Klein, and J. Rosenfeld. 1992. Analysts' use of information about permanent and transitory earnings components in forecasting annual EPS. *Accounting Review* 183-98.
- Ayers, B. C., O. Z. Li, and P. E. Yeung. 2011. Investor Trading and the Post-Earnings-Announcement Drift. *The Accounting Review* 86: 385-416.
- Badertscher, B. A., S. P. Hribar, and N. T. Jenkins. 2011. Informed Trading and the Market Reaction to Accounting Restatements. *Accounting Review* 86: 1519-47.
- Ball, R., and P. Brown. 1968. An Empirical Evaluation of Accounting Income Numbers. *Journal of Accounting Research* 6: 159-78.
- Bartov, E., D. Givoly, and C. Hayn. 2002. The rewards to meeting or beating earnings expectations. *Journal of Accounting and Economics* 33: 173-204.
- Bartov, E., S. Radhakrishnan, and I. Krinsky. 2000. Investor Sophistication and Patterns in Stock Returns after Earnings Announcements. *The Accounting Review* 75: 43-63.
- Battalio, R. H., and R. R. Mendenhall. 2005. Earnings expectations, investor trade size, and anomalous returns around earnings announcements. *Journal of Financial Economics* 77: 289-319.
- Beneish, M. D., E. Press, and M. E. Vargus. 2012. Insider Trading and Earnings Management in Distressed Firms. *Contemporary Accounting Research* 29: 191-220.
- Beneish, M. D., and M. E. Vargus. 2002. Insider Trading, Earnings Quality, and Accrual Mispricing. *Accounting Review* 77: 755-91.
- Bernard, V. L., and J. K. Thomas. 1990. Evidence that stock prices do not fully reflect the implications of current earnings for future earnings. *Journal of Accounting and Economics* 13: 305-40.
- Bhattacharya, N., H. Desai, and K. Venkataraman. 2013. Does Earnings Quality Affect Information Asymmetry? Evidence from Trading Costs. *Contemporary Accounting Research* 30: 482-516.
- Brav, A., and J. B. Heaton. 2002. Competing theories of financial anomalies. *Review of Financial Studies* 15: 575-606.
- Brochet, F. 2010. Information content of insider trades before and after the Sarbanes-Oxley Act. *Accounting Review* 85: 419-46.
- Brown, L. D., and M. L. Caylor. 2005. A Temporal Analysis of Quarterly Earnings Thresholds: Propensities and Valuation Consequences. *The Accounting Review* 80: 423-40.
- Brown, L. D., and K.-J. Kim. 1991. Timely Aggregate Analyst Forecasts As Better Proxies for Market Earnings Expectations. *Journal of Accounting Research* 29: 382-85.
- Bulkley, G., and I. Tonks. 1989. Are UK stock prices excessively volatile? Trading rules and variance bound tests. *Economic Journal* 99: 1083-98.
- Campbell, C. J., A. R. Cowan, and V. Salotti. 2010. Multi-country event-study methods. *Journal of Banking & Finance* 34: 3078-90.
- Chordia, T., and L. Shivakumar. 2005. Inflation Illusion and Post-Earnings-Announcement Drift. *Journal of Accounting Research* 43: 521-56.
- Chui, A. C., S. Titman, and K. J. Wei. 2010. Individualism and momentum around the world. *The Journal of Finance* 65: 361-92.
- Core, J., W. Guay, S. Richardson, and R. Verdi. 2006. Stock Market Anomalies: What Can We Learn from Repurchases and Insider Trading? *Review of Accounting Studies* 11: 49-70.

- Dechow, P. M., and I. D. Dichev. 2002. The Quality of Accruals and Earnings: The Role of Accrual Estimation Errors. *The Accounting Review* 77: 35-59.
- Dechow, P. M., R. G. Sloan, and A. P. Sweeney. 1995. Detecting Earnings Management. *The Accounting Review* 70: 193-225.
- Dellavigna, S., and J. M. Pollet. 2009. Investor Inattention and Friday Earnings Announcements. *The Journal of Finance* 64: 709-49.
- Fidrmuc, J. P., M. Goergen, and L. U. C. Renneboog. 2006. Insider Trading, News Releases, and Ownership Concentration. *Journal of Finance* 61: 2931-73.
- Francis, J., R. Lafond, P. Olsson, and K. Schipper. 2007. Information uncertainty and post-earnings-announcement-drift. *Journal of Business Finance & Accounting* 34: 403-33.
- Freeman, R. N., and S. Y. Tse. 1992. A nonlinear model of security price responses to unexpected earnings. *Journal of Accounting Research* 185-209.
- García Lara, J. M., B. García Osma, and A. Mora. 2005. The Effect of Earnings Management on the Asymmetric Timeliness of Earnings. *Journal of Business Finance & Accounting* 32: 691-726.
- Garfinkel, J. A. 1997. New evidence on the effects of federal regulations on insider trading: The Insider Trading and Securities Fraud Enforcement Act (ITSFEA). *Journal of Corporate Finance* 3: 89-111.
- Gregory, A., J. Matatko, and I. Tonks. 1997. Detecting information from directors' trades: signal definition and variable size effects. *Journal of Business Finance & Accounting* 24: 309-42.
- Gregory, A., J. Matatko, I. Tonks, and R. Purkis. 1994. UK Directors' Trading: The Impact of Dealings in Smaller Firms. *The Economic Journal* 104: 37-53.
- Hew, D., L. Skerratt, N. Strong, and M. Walker. 1996. Post-earnings-announcement Drift: Some Preliminary Evidence for the UK. *Accounting & Business Research (Wolters Kluwer UK)* 26: 283-93.
- Hillier, D., and A. P. Marshall. 1998. The Timing of Directors' Trades. *Journal of Business Law* 454-67.
- . 2002a. Are trading bans effective? Exchange regulation and corporate insider transactions around earnings announcements. *Journal of Corporate Finance* 8: 393.
- . 2002b. The Market Evaluation of Information in Directors Trades. *Journal of Business Finance & Accounting* 29: 77.
- Hirshleifer, D., S. S. Lim, and S. H. Teoh. 2009. Driven to Distraction: Extraneous Events and Underreaction to Earnings News. *The Journal of Finance* 64: 2289-325.
- Hirshleifer, D. A., J. N. Myers, L. A. Myers, and S. H. Teoh. 2008. Do Individual Investors Cause Post-Earnings Announcement Drift? Direct Evidence from Personal Trades. *The Accounting Review* 83: 1521-50.
- Huddart, S., B. Ke, and C. Shi. 2007. Jeopardy, non-public information, and insider trading around SEC 10-K and 10-Q filings. *Journal of Accounting and Economics* 43: 3-36.
- Hung, M., X. Li, and S. Wang. 2014. Post-earnings-announcement drift in global markets: Evidence from an information shock. *Review of Financial Studies*.
- Ince, O. S., and R. B. Porter. 2006. Individual equity return data from Thomson Datastream: handle with care! *Journal of Financial Research* 29: 463-79.
- John, K., and L. H. P. Lang. 1991. Insider Trading around Dividend Announcements: Theory and Evidence. *Journal of Finance* 46: 1361-89.
- Jones, J. J. 1991. Earnings Management During Import Relief Investigations. *Journal of Accounting Research* 29: 193-228.
- Kim, D., and M. Kim. 2003. A Multifactor Explanation of Post-Earnings Announcement Drift. *The Journal of Financial and Quantitative Analysis* 38: 383-98.

- Kolasinski, A., and X. Li. 2010. Are corporate managers savvy about their stock price? Evidence from insider trading after earnings announcements. *Journal of Accounting and Public Policy* 29: 27-44.
- Korczak, A., P. Korczak, and M. Lasfer. 2010. To Trade or Not to Trade: The Strategic Trading of Insiders around News Announcements. *Journal of Business Finance and Accounting* 37: 369-407.
- Kothari, S. P. 2001. Capital markets research in accounting. *Journal of Accounting and Economics* 31: 105-231.
- Kothari, S. P., A. J. Leone, and C. E. Wasley. 2005. Performance matched discretionary accrual measures. *Journal of Accounting and Economics* 39: 163-97.
- Lakonishok, J., and I. Lee. 2001. Are insider trades informative? *Review of Financial Studies* 14: 79-111.
- Lee, K.-H. 2011. The world price of liquidity risk. *Journal of Financial Economics* 99: 136-61.
- Leland, H. E. 1992. Insider trading: Should it be prohibited? *Journal of Political Economy* 859-87.
- Lewellen, J., and J. Shanken. 2002. Learning, asset-pricing tests, and market efficiency. *Journal of Finance* 57: 1113-45.
- Liang, L. 2003. Post-Earnings Announcement Drift and Market Participants' Information Processing Biases. *Review of Accounting Studies* 8: 321-45.
- Liu, W., N. Strong, and X. Xu. 2003. Post-earnings-announcement Drift in the UK. *European Financial Management* 9: 89-116.
- Louis, H., and A. X. Sun. 2011. Earnings Management and the Post-earnings Announcement Drift. *Financial Management* 40: 591-621.
- Manne, G. H. 1966. *Insider Trading and the stock market*. New York: The Free Press.
- Maynes, E., and J. Rumsey. 1993. Conducting event studies with thinly traded stocks. *Journal of Banking & Finance* 17: 145-57.
- Mendenhall, R. R. 1991. Evidence on the possible underweighting of earnings-related information. *Journal of Accounting Research* 170-79.
- Mendenhall, Richard R. 2004. Arbitrage Risk and Post-Earnings-Announcement Drift. *The Journal of Business* 77: 875-94.
- Ng, J., T. O. Rusticus, and R. S. Verdi. 2008. Implications of Transaction Costs for the Post-Earnings Announcement Drift. *Journal of Accounting Research* 46: 661-96.
- Pastor, L., and P. Veronesi. 2009. Learning in Financial Markets. *Annual Review of Financial Economics* 1: 361-81.
- Piotroski, J. D., and D. T. Roulstone. 2007. Evidence on the non-linear relation between insider trading decision and future earnings. *Journal of Law, Economics & Policy* 4: 409-48.
- Pope, P. F., R. C. Morris, and D. A. Peel. 1990. Insider trading: some evidence on market efficiency and directors' share dealings in Great Britain. *Journal of Business Finance & Accounting* 17: 359-80.
- Richardson, S., Í. Tuna, and P. Wysocki. 2010. Accounting anomalies and fundamental analysis: A review of recent research advances. *Journal of Accounting and Economics* 50: 410-54.
- Roulstone, D. T. 2008. InsiderTrading and the Information Content of Earnings Announcement. *Working Paper*.
- Sawicki, J., and K. Shrestha. 2008. Insider Trading and Earnings Management. *Journal of Business Finance & Accounting* 35: 331-46.
- Seyhun, N. 1998. *Investment intelligence from insider trading*. The MIT Press.
- Sivakumar, K., and G. Waymire. 1994. Insider Trading Following Material News Events: Evidence from Earnings. *Financial Management* 23: 23-32.

- Soffer, L. C., and T. Lys. 1999. Post-Earnings Announcement Drift and the Dissemination of Predictable Information. *Contemporary Accounting Research* 16: 305-31.
- Timmermann, A. 1996. Excess volatility and predictability of stock prices in autoregressive dividend models with learning. *The Review of Economic Studies* 63: 523-57.
- Timmermann, A. G. 1993. How learning in financial markets generates excess volatility and predictability in stock prices. *The Quarterly Journal of Economics* 1135-45.
- Udpa, S. C. 1996. Insider trading and the information content of earnings. *Journal of Business Finance & Accounting* 23: 1069-95.
- Veenman, D. 2012. Disclosures of Insider Purchases and the Valuation Implications of Past Earnings Signals. *The Accounting Review* 87: 313-42.
- Veenman, D., A. Hodgson, B. Van Praag, and W. Zhang. 2011. Decomposing Executive Stock Option Exercises: Relative Information and Incentives to Manage Earnings. *Journal of Business Finance & Accounting* 38: 536-73.
- Vega, C. 2006. Stock price reaction to public and private information. *Journal of Financial Economics* 82: 103-33.